REQUEST FOR COMMENTS/TSD ON STATE IMPLEMENTATION PLAN REVISIONS Sect F311

TO:

	AIR PLANNING SECTION	cover letter	AIR COMPLIANCE BRANCH
2	TECHNICAL ANALYSIS SECTION		ENVIRONMENTAL SERVICES DIV.
cover letter	REGIONAL COUNSEL		DIVISION DIRECTOR, AMD
	STATE SPECIALIST	cover letter	BRANCH CHIEF, ARB
	REGULATORY ANALYSIS SECTION		STATE COORDINATOR
1	REGULATORY SPECIALIST	2	DOCKET COPY 1 orig FILE COPY
1	WRITER U. McMahan		PIRU, CPDD, OGC, SSCD,
	OTHER		FOSD, OP&E, ECTD, OFR,
			STATE

F031 F311

WI 031 WI 311

FROM: C. Comerford, REGULATORY SPECIALIST: _____

DATE: 7/29/86, PHONE: 6-6034

PLEASE REVIEW AND PROVIDE COMMENTS/TSD BY DUE DATE. IF YOU HAVE NO COMMENTS PLEASE CHECK HERE AND RETURN: _____, DATE: _____

SUBMITTAL DESCRIPTION

DOCKET NO. AND TITLE: F031 Wisconsin Stack Height Revisions / F311 Wisconsin Statewide SO_2 Rule

STATE: ___ILL, ___IND, ___MICH, ___MINN, ___OHIO, ✓WISC, ___OTHER

AREA: ___STATEWIDE, ___AREA SPECIFIC, ✓SITE SPECIFIC, ___OTHER:

TYPE OF SUBMITTAL: ___PART D, ✓SITE SPECIFIC, ___MISC.

STATE OF DEVELOPMENT: ✓DRAFT, ___FINAL, ___OTHER:

POLLUTANT: ___O_3, ___CO, ___TSP, ✓SO_2, ___VOC, ___NO_2, ___Pb, ___OTHER:

SUBMITTED BY: Thilmany Paper, COVER LETTER DATE: 7/25/86, DATE RECEIVED: 7/28/86

RC/ACB/ESD/DUE DATE: _____

_____ TO PREPARE TSD BY _____ (DATE)

SPECIAL NOTE: WI 7/28/86 RK

Thilmany Paper submits additional info on their fluid modeling study. Study was performed in conjunction with their request for an alternate emission limit under the Statewide SO_2 rule.

TRANSMIT A COPY OF YOUR COMMENTS TO: GARY GULEZIAN
cc: UYLAINE MCMAHAN
AIR AND RADIATION BRANCH
PHONE: 353-0396

CREATE RAS AND DOCKET FILES _____

SUBMIT ORIGINAL TO RAS FILES NO. WI 031 / DOCKET FILE NO. F 031

WI 311 F 311

WIS TACC STACK

RAS

Phone: 414-766-4611
TWX: 910-270-1190

Thilmany THILMANY PULP & PAPER CO. • P.O. BOX 600 • KAUKAUNA, WISCONSIN 54130

July 25, 1986

Mr. Steve Rothblatt, Chief
Air & Radiation Branch
United States Environmental Protection Agency
Region 5
230 South Dearborn Street
Chicago, IL 60604

Re: May 14, 1986 Final Report on Fluid Modeling Study
Thilmany Pulp & Paper Company

Dear Mr. Rothblatt:

Your June 30, 1986 letter to Mr. Donald Theiler provided Agency comments with regard to the final report entitled "Excessive Concentration Demonstration for Thilmany Pulp & Paper Company" by Cermak/Peterka and Associates. The letter ended by stating that additional documentation was needed to fulfil the requirements of EPA's Fluid Modeling Guideline.

Cermak/Peterka and Associates have provided this additional documentation. Enclosed is their July 17, 1986 letter with responses addressed in the same order as the comments in your June 30, 1986 letter.

We look forward to the Agency's approval of the fluid modeling study so that Thilmany's alternate sulfur dioxide emission limit request can be expeditiously approved by the Department of Natural Resources.

If there are any questions concerning this additional documentation, please contact Tom Jayne or Hal Martin at (414) 766-4611.

Sincerely,

A. H. Martin

A. H. Martin
Manager, Environmental Services

AHM/am
cc: Mr. Donald Theiler - DNR MAdison
Mr. Ralph Patterson - DNR Madison
Mr. Dan Schramm - DNR Green Bay
Dr. Perry Fischer - Dawes & Moore
Atty. Mark Thimke - Foley & Lardner

C/PA

Wind Engineering Consultants

17 July 1986

THILMANY PULP and PAPER COMPANY
Thilmany Road
P.O. Box 600
Kaukauna, Wisconsin 54130

Attn: Mr. Thomas G. Jayne

Re: Excessive Concentration Demonstration for Thilmany Pulp and Paper Company's Kaukauna Kraft Mill
C/PA Project 86-0306

Dear Mr. Jayne:

This letter is written to respond to the comments in Steve Rothblatt's letter dated June 30, 1986 concerning the above referenced wind tunnel study. The responses are addressed in the same order as the comments in Rothblatt's letter.

Atmospheric Dispersion Comparability Test

According to the "Guideline for use of Fluid Modeling to Determine Good Engineering Practice Stack Height", temperature profiles are not required if the free stream wind is greater than 3 m/s. Since all tests were conducted at a speed of 3.5 m/s, no temperature profiles were obtained. C/PA did, however, recently take a temperature profile for a similar wind tunnel setup at a similar wind speed. The profile is shown in attachment 1 and demonstrates a constant temperature versus height.

Corrected Figures B3 through B5 are attached.

Demonstration of Adverse Effects

The evaluation of the velocity and turbulence profiles with the Thilmany model in the wind tunnel is given on pages 12 and 13 of our report. This evaluation includes all required documentation except an evaluation of the mean velocity characteristics which is included below.

The surface roughness factor (z_0) and friction velocity (u^*) were determined from the profiles shown in Figure 7 of our report by fitting the velocity data to the following equation:

$$u/U_\infty = 2.5\ (u^*/U_\infty)\ \ell n(z/z_0).$$

Cermak/Peterka & Associates Inc.
1415 Blue Spruce Drive
Fort Collins, CO 80524
(303) 221-3371

The results of the best-fit analysis are shown in the attached Table. The z_o values range from 5.9 to 155 cm with the structures present and from 1.9 to 57.6 cm without the nearby structures present. The low z_o values are representative of a site with high grass. The high values are expected immediately downwind of structures. The table also shows the expected result of larger z_o and u^* values with the structures present.

Counihan (1975) presents the following formula for computing u^{*2} from z_o:

$$u^{*2}/U_\infty^2 = 2.75 \times 10^{-3} + 6 \times 10^{-4} \log_{10} z_o$$

where z_o is in meters.

Setting z_o = 0.06 and 1.55 m gives 0.045 and 0.054 for the expected values of u^*/U_∞. The expected values are approximately equal to those observed in the wind tunnel except near the buildings. Hence, the friction velocity is representative of that desired for the observed surface roughness.

To determine the power law exponent (n), the mean velocity data were fit to the following equation using a least-squares technique:

$$u/U_\infty = (z/z_\infty)^n.$$

The observed n values range from 0.13 to 0.65. The expected power law index for neutral stratification and the appropriate site roughness can be predicted from Counihan (1975) as follows:

$$n = 0.096 \log_{10} z_o + 0.016 (\log_{10} z_o)^2 + 0.24.$$

Substituting z_o = 0.06 and 1.55 gives an expected range for n of 0.15 to 0.26, in comparison with an observed range of 0.13 to 0.65. Immediately downwind of the structure the power law and log-law do not describe the velocity distribution, hence the z_o, u^*/U_∞ and n values are not meaningful.

The desired boundary-layer thickness for neutral stratification is 100 cm (600 m full scale). If the boundary-layer thickness is defined to be the point where the profiles become constant, the observed values range from 80 to 100cm.

In summary, the results presented here show that the velocity profiles are affected by the presence of the structures and are representative of profiles expected in the atmosphere.

Determination of Excessive Concentration

The fluid modeling guideline gives the following equation for converting model concentrations to full scale concentrations:

$$C_f = C_m(U_m/U_f)\ (H_m/H_p)^2\ (Q_f/Q_m)$$

where

C = mass concentration of pollutant ($\mu g/m^3$)

U = wind speed (m/s)

H = characteristic length (m)

Q = pollutant emission rate ($\mu g/s$)

The equation used in the Thilmany report was identical except C_m was replaced with X_m and Q_m was replaced with $(X_o\ V)_m$ where X_m is the tracer concentration in ppm, X_o the source concentration in ppm and V the volume flow rate in m^3/s. For the techniques to be equivalent $(C/Q)_m$ must equal $(X/X_o\ V)_m$.

C_m can be converted to X_m using the following equation:

$$C_m = [f\ X\ \rho_t]_m$$

where ρ_t is the tracer gas density and f is the conversion factor to obtain the correct units. By definition

$$Q_m = (f\ X_o\ V\ \rho_t)_m.$$

Now

$$\begin{aligned} Cm/Qm &= [f\ X\ \rho_t]_m\ /\ [f\ X_o\ V\ \rho_t]_m \\ &= X_m\ /\ [X_o\ V]_m \end{aligned}$$

Therefore the techniques are identical.

C/PA

Wind Engineering Consultants

The above discussion addresses all issues that required comment in Rothblatt's letter. If you need additional information, please call.

Very truly yours,

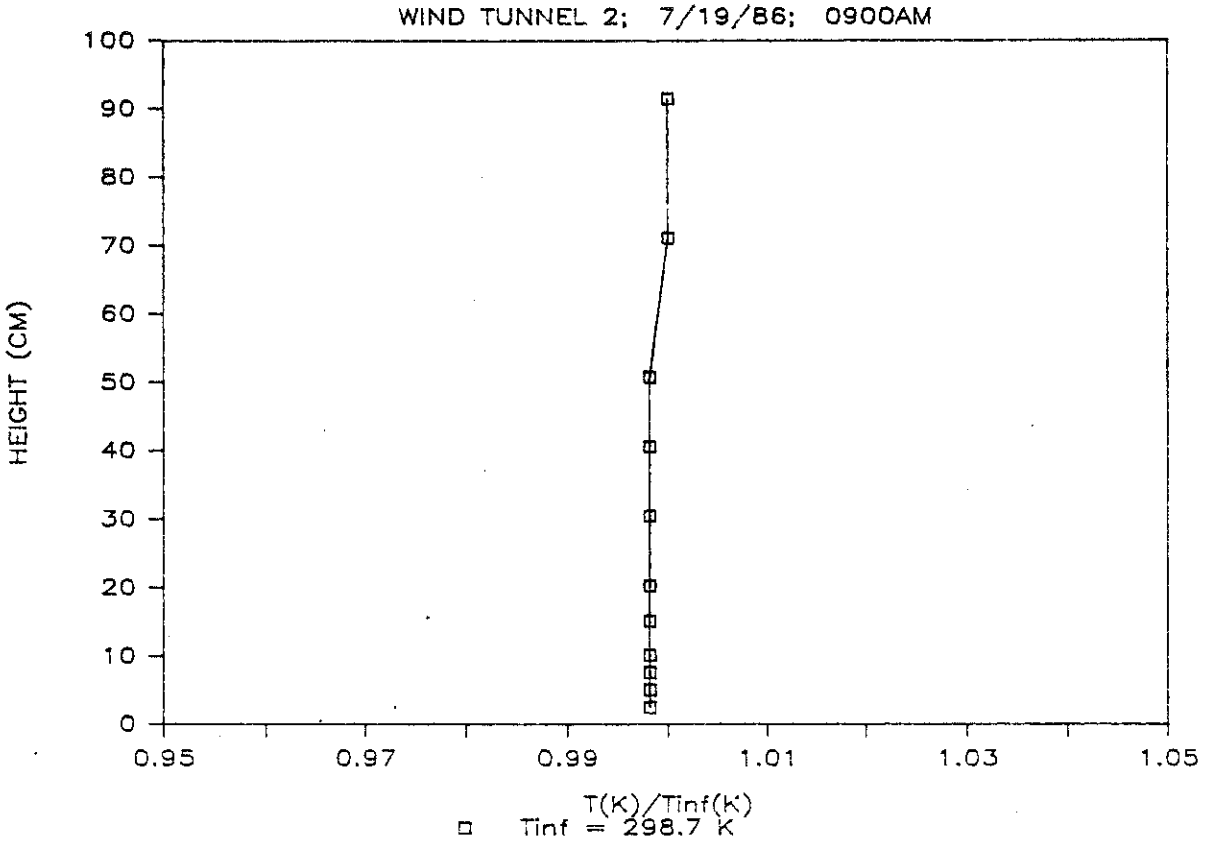
CERMAK/PETERKA ASSOCIATES, INC.
Wind Engineering Consultants

By
Ronald L. Petersen, Ph.D.
Vice President

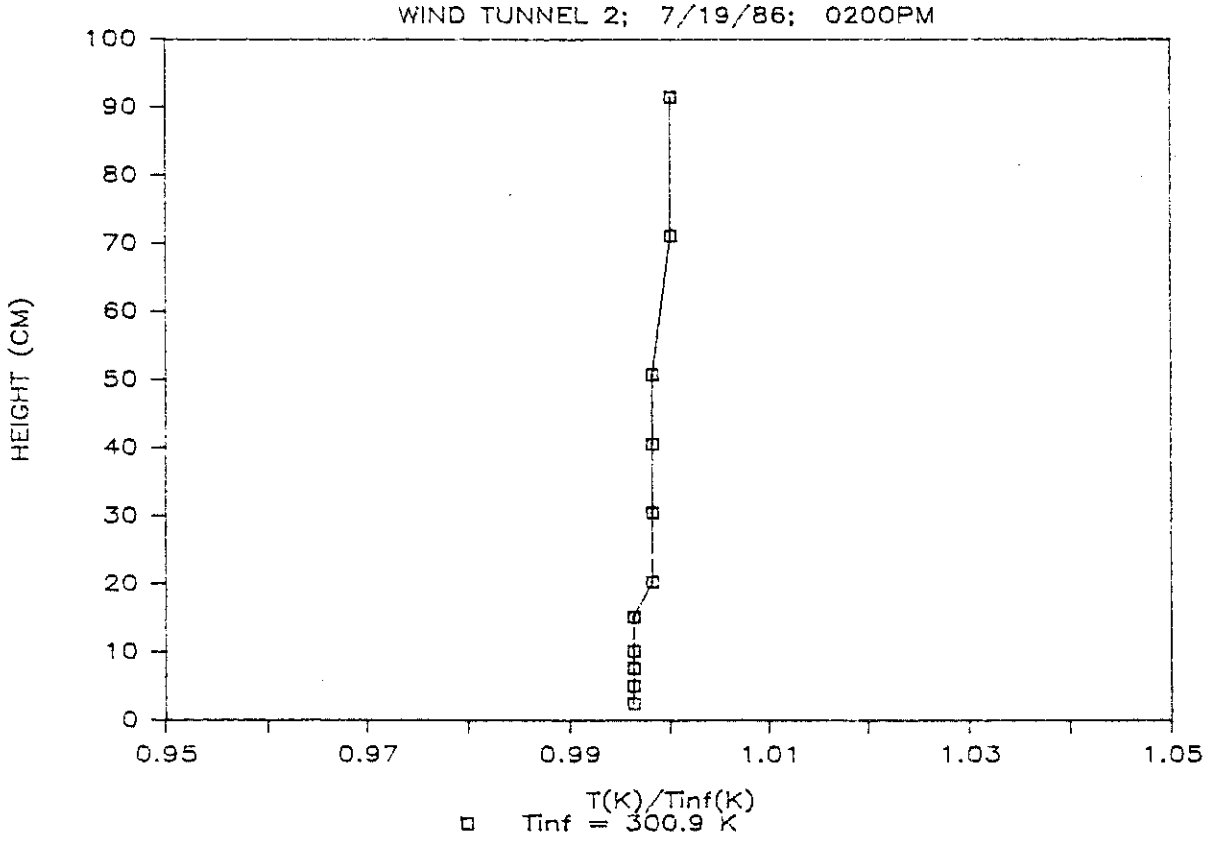
RLP:mm

Enclosures

TEMPERATURE PROFILE AT Uinf = 3.5 m/:



TEMPERATURE PROFILE AT Uinf = 3.5 m/:



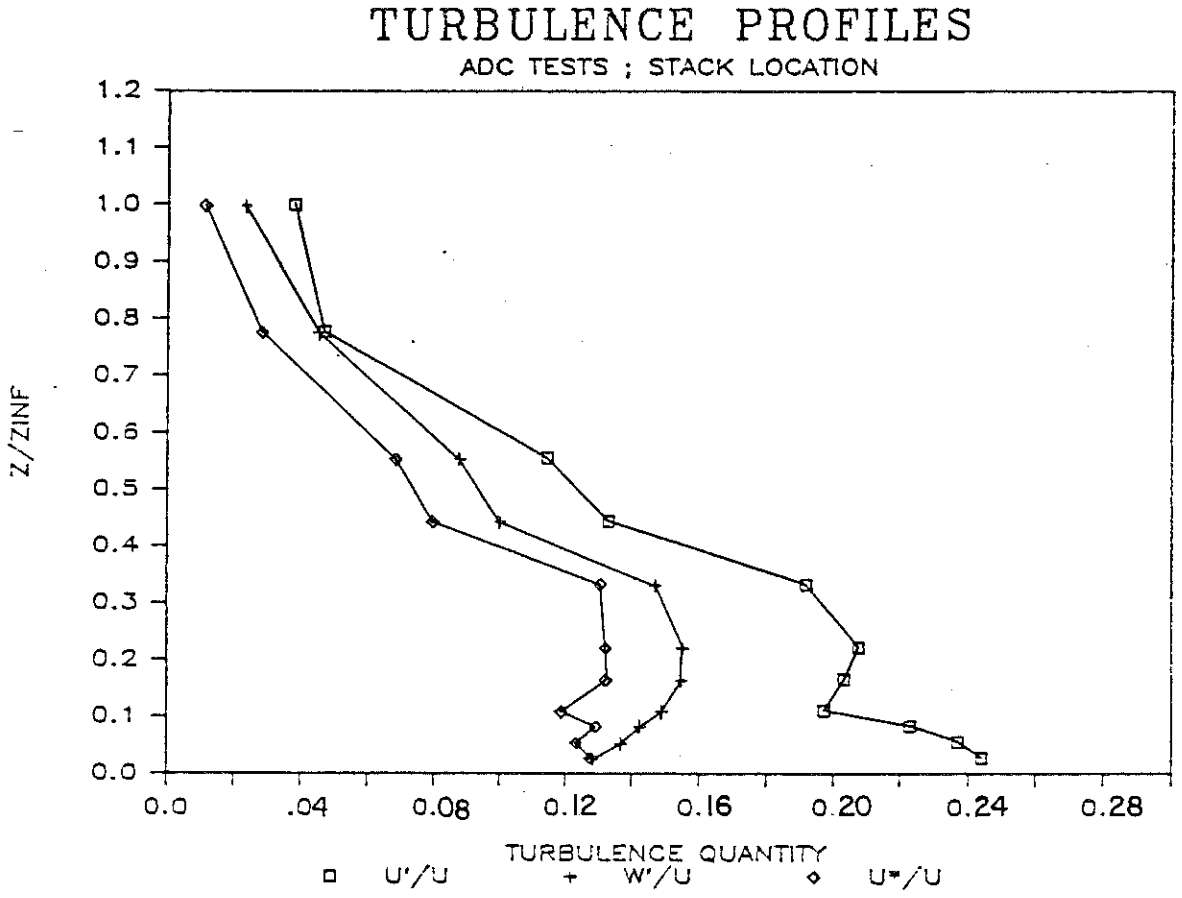


Figure B-3 Turbulence intensity (u'/u and w'/u and Reynolds stress (u*/u) profiles in the simulated Atmospheric boundary layer (ABL) over flat terrain at stack location

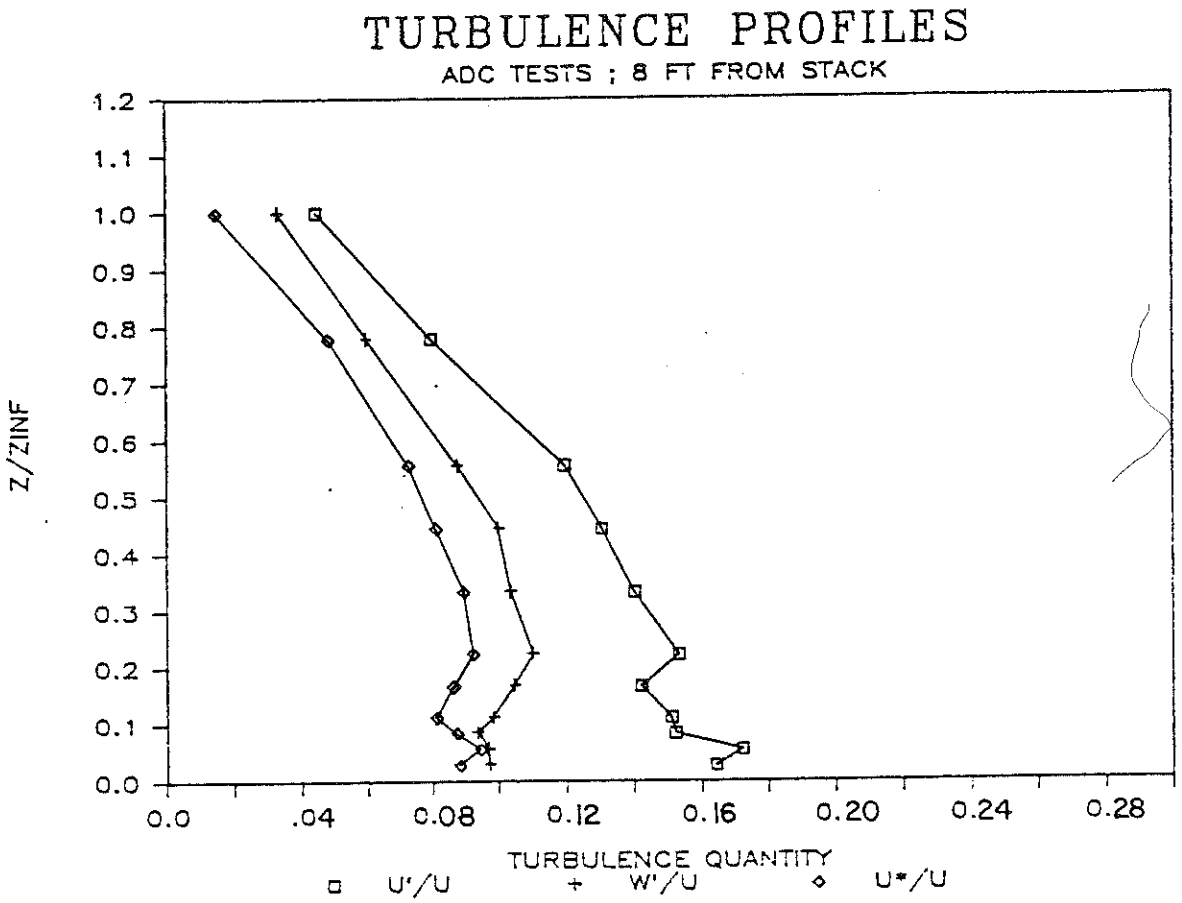


Figure B-4 Turbulence intensity (u'/u and w'/u) and Reynolds stress (u*/u) profiles in the simulated Atmospheric boundary layer (ABL) over flat terrain 1.83 m downwind from the stack

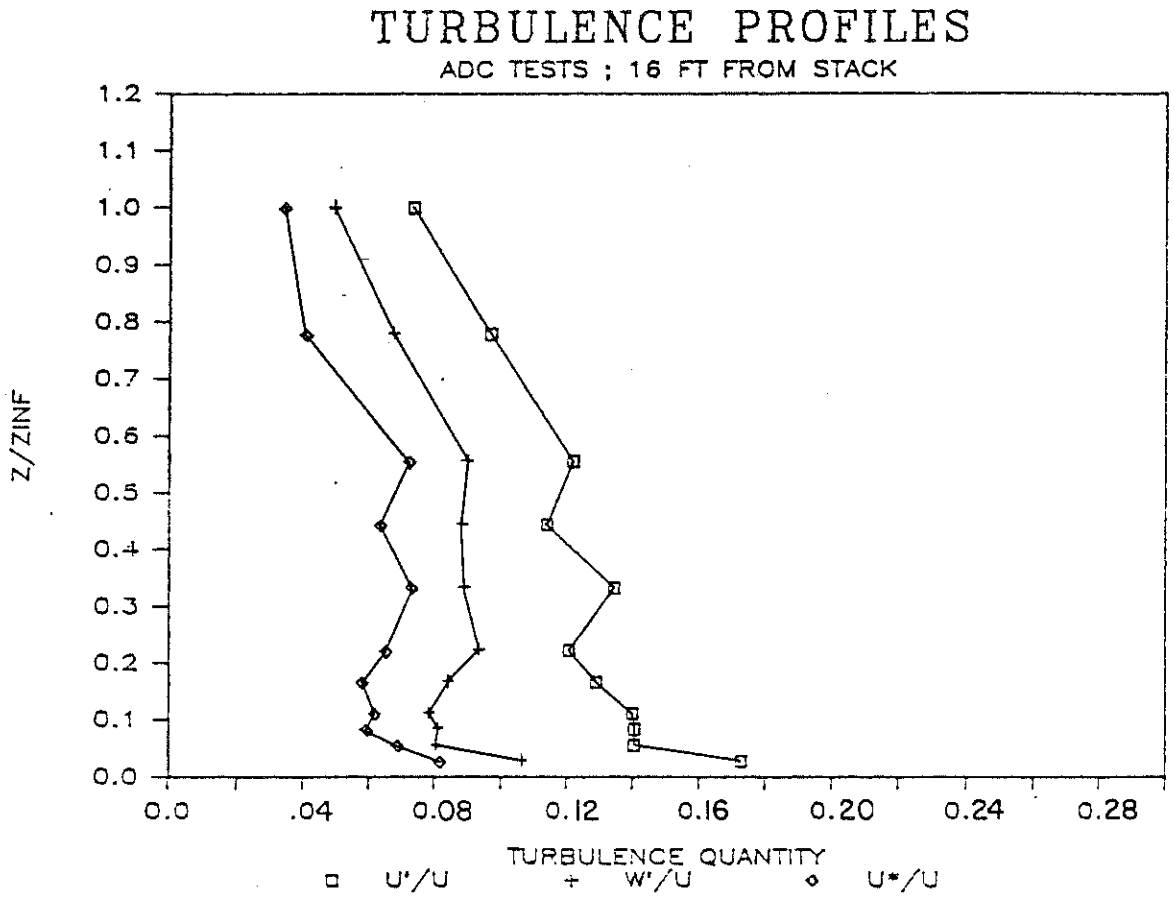


Figure B-5 Turbulence intensity (u'/u) and w'/u) and Reynolds stress (u*/u) profiles in the simulated Atmospheric boundary layer (ABL) over flat terrain 3.66 m downwind from the stack

Table

Summary of Velocity Profile

Characteristics With and Without Structures

Location (km)	Buildings	$(z_o)_f$ (cm)	u^*/U_∞	n
0.0	IN	155	0.155	0.648
0.7		30.7	0.060	0.215
1.4		5.9	0.051	0.155
0	OUT	57.6	0.066	0.175
0.7		0.6	0.034	0.138
1.4		1.9	0.044	0.133